

**What is claimed is:**

- 1        1.    A method for I/Q mismatch calibration in a  
2 receiver having an I/Q correction module using parameters  $A_p$   
3 and  $B_p$ , the method comprising the steps of:  
4        generating an analog test signal  $x(t)$  containing  
5                 $\cos(2\pi(f_c + f_T)t)$ , where  $f_c$  and  $f_T$  are predetermined  
6                real numbers;  
7        applying I/Q demodulation to reduce the central  
8                frequency of the signal  $x(t)$  by  $f_c$  Hz and  
9                outputting a demodulated signal  $x_{dem}(t)$ ;  
10       converting the analog signal  $x_{dem}(t)$  to a digital signal  
11         $x_{dem}[n]$  with a preset sampling rate of  $f_s$  Hz;  
12       sending the signal  $x_{dem}[n]$  into the I/Q correction  
13               module using parameters  $A_p$  and  $B_p$  and outputting a  
14               corrected signal  $w[n]$ ;  
15       obtaining two measures  $U_1$  and  $U_2$  of the corrected  
16               signal  $w[n]$  where  $U_1$  and  $U_2$  are values indicative  
17               of the discrete-Fourier transform of  $w[n]$   
18               corresponding to frequency  $+f_T$  Hz and  $-f_T$  Hz,  
19               respectively; and  
20       updating the parameters  $A_p$  and  $B_p$  of the I/Q correction  
21               module respectively by a first and second  
22               function of the two measures  $U_1$  and  $U_2$ , and the  
23               current values of the parameters  $A_p$  and  $B_p$ .  
  
1        2.    The method as claimed in claim 1, wherein the I/Q  
2 correction module implements a function:  
3                $w[n] = A_p \cdot x_{dem}[n] + B_p \cdot x_{dem}^*[n]$ ,  
4        where the superscript \* refers to a complex conjugate.

3. The method as claimed in claim 1, wherein the first and second function are respectively:

$$A'_p = A_p - \mu \cdot B_p^* \cdot U_1 \cdot U_2; \text{ and}$$

$$B'_p = B_p - \mu \cdot A_p^* \cdot U_1 \cdot U_2,$$

where  $A'_p$  and  $B'_p$  are the updated values,  $A_p$  and  $B_p$  are the current values, and  $\mu$  is a preset step size parameter.

4. The method as claimed in claim 1, wherein:

$$f_T = \frac{K}{M} f_s,$$

where  $K$  and  $M$  are integers and the measures  $U_1$  and  $U_2$  are respectively obtained by:

$$U_1 = \frac{1}{M} \sum_{n=0}^{M-1} w[n] \cdot e^{-j2\pi \frac{K}{M} n}; \text{ and}$$

$$U_2 = \frac{1}{M} \sum_{n=0}^M w[n] \cdot e^{j2\pi \frac{K}{M} n}.$$

5. The method as claimed in claim 1 further comprising the step of:

normalizing the updated parameters  $A_p$  and  $B_p$  so that the power of the corrected signal  $w[n]$  is the same as that of the digital signal  $x_{dem}[n]$ .

6. An apparatus for I/Q mismatch calibration of a receiver, comprising:

a signal generator generating an analog test signal  $x(t)$  containing  $\cos(2\pi(f_c + f_T)t)$ , where  $f_c$  and  $f_T$  are predetermined real numbers;

6        a demodulator applying I/Q demodulation to reduce the  
7                central frequency of the signal  $x(t)$  by  $f_c$  Hz and  
8                outputting a demodulated signal  $x_{dem}(t)$ ;  
9        A/D converters converting the analog signal  $x_{dem}(t)$  to a  
10                digital signal  $x_{dem}[n]$  with a preset sampling rate  
11                of  $f_s$  Hz;  
12        an I/Q correction module using parameters  $A_p$  and  $B_p$  to  
13                compensate I/Q mismatch in the signal  $x_{dem}[n]$  and  
14                outputting a corrected signal  $w[n]$ ;  
15        a dual-tone correlator outputting two measures  $U_1$  and  
16                 $U_2$  of the corrected signal  $w[n]$  where  $U_1$  and  $U_2$   
17                are values indicative of the discrete-Fourier  
18                transform of  $w[n]$  corresponding to frequency  $+f_T$   
19                Hz and  $-f_T$  Hz, respectively; and  
20        a processor implementing the step of:  
21                updating the parameters  $A_p$  and  $B_p$  of the I/Q  
22                correction module respectively by a first  
23                and second function of the two measures  $U_1$   
24                and  $U_2$ , and the current values of the  
25                parameters  $A_p$  and  $B_p$ .

1        7.    The apparatus as claimed in claim 6, wherein the  
2        processor further implements the step of:

3                normalizing the updated parameters  $A_p$  and  $B_p$  so that  
4                the power of the corrected signal  $w[n]$  is the  
5                same as that of the digital signal  $x_{dem}[n]$ .

1        8.    The apparatus as claimed in claim 6, wherein the  
2        first and second function are respectively:

3                 $A'_p = A_p - \mu \cdot B_p^* \cdot U_1 \cdot U_2$ ; and

4  $B_p' = B_p - \mu \cdot A_p^* \cdot U_1 \cdot U_2$  ,  
 5 where  $A_p'$  and  $B_p'$  are the updated values,  $A_p$  and  $B_p$  are  
 6 the current values, and  $\mu$  is a preset step size  
 7 parameter.

1 9. The apparatus as claimed in claim 6, wherein the  
 2 I/Q correction module implements a function:

3  $w[n] = A_p \cdot x_{dem}[n] + B_p \cdot x_{dem}^*[n]$  ,  
 4 where the superscript \* refers to a complex conjugate.

1 10. The apparatus as claimed in claim 6, wherein :

$$2 \quad f_T = \frac{K}{M} f_s ,$$

3 where  $K$  and  $M$  are integers and the measures  $U_1$  and  $U_2$   
 4 are respectively obtained by:

$$5 \quad U_1 = \frac{1}{M} \sum_{n=0}^{M-1} w[n] \cdot e^{-j2\pi \frac{K}{M} n} ; \text{ and}$$

$$6 \quad U_2 = \frac{1}{M} \sum_{n=0}^M w[n] \cdot e^{j2\pi \frac{K}{M} n} .$$